(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 676 501 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **95104730.7**

(22) Date of filing: **30.03.95**

(51) Int. Cl.[6]: **D21F 3/08**, D21G 3/00, D21G 9/00

(30) Priority: **08.04.94 FI 941620**

(43) Date of publication of application:
11.10.95 Bulletin 95/41

(84) Designated Contracting States:
AT DE FR GB IT SE

(71) Applicant: **VALMET PAPER MACHINERY INC.**
Panuntie 6
SF-00620 Helsinki (FI)

(72) Inventor: **Vestola, Juhani**
Tähtäin 25
SF-40630 Jyväskylä (FI)
Inventor: **Harinen, Pekka**
Nuolikatu 7
SF-40630 Jyväskylä (FI)

(74) Representative: **Tiedtke, Harro, Dipl.-Ing.**
Patentanwaltsbüro
Tiedtke-Bühling-Kinne & Partner
Bavariaring 4
D-80336 München (DE)

(54) Method and equipment in conditioning the coating on a roll in a paper machine.

(57) The invention concerns a method and an equipment in conditioning of the coating (10') on a roll (10) in a paper machine, which coating is ceramic or metal-ceramic. The roll (10) is ground periodically by means of a grinding member (21), which is mounted on the doctor (19) of the roll (10). The grain size of the grinding particles in the grinding member (21), i.e. the average diameter of the particles, is in the range of 15...200 µm. In the grinding situation, the roll (10) is rotated in its site of operation, and the grinding member (21) is pressed with a force into contact with the face to be ground, whereby, if the face to be ground is excessively rough, it is smoothed to the desired value of surface roughness and, in a corresponding way, an excessively smooth face is roughened to the desired surface roughness value determined by the grinding member (21).

FIG. 1A

EP 0 676 501 A2

The invention concerns a method and an equipment in conditioning of the coating on a roll in a paper machine.

A porous face of a press roll tends to gather, and to be coated with, the doctor material, such as epoxy. If the coating is excessive, the roll face may become excessively smooth, which results in more difficult separation of the paper web from the centre roll of the press and in passage through the doctor, with resulting tendency of web breaks. Also, an excessive roughening of the face results in similar deterioration of the capacity of operation of the face. Smoothing and roughening of the roll face is characteristic expressly of a roll that includes a ceramic coating material.

In order that the face could be kept at its roughness value (RA value) optimal in view of the operation, the roll face must be ground.

Thus, in the present application, it is suggested that the roll face be conditioned periodically and on the site without removing the roll. In the solution in accordance with the present invention, the doctor of the roll to be conditioned is provided with a separate grinding member, which is mounted on the actuators of the doctors and which is brought, by means of the doctor, into contact with the face to be ground. Said members comprise a back-up part, whose shape corresponds to the curve form of the roll face closely and to which back-up part a grinding band and a separate soft cushion part are attached, said cushion part permitting an elastic grinding result and consideration given to any differences in shape between the faces placed against each other during grinding. The roll is ground expressly in its site of operation.

In the solution in accordance with the invention, it is essential that a grinding member is chosen with which the grinding result is always correct irrespective of whether the face is to be made smoother by grinding or whether an excessively smooth face is to be roughened. Thus, according to the invention, a separate grinding member has been chosen in which the diameter size of the grinding particles is in the range of 15...200 µm. Preferably a diamond grinding band is used. During grinding, the grinding member is oscillated in the axial direction of the roll, while the oscillation device of the doctor is used for the oscillation. The grinding member is pressed with a force of about 100...1200 N/m (force per unit of length) against the face to be ground. The roll is rotated at a low circumferential speed of about 10...200 m/min. Preferably, a water jet is applied to the roll face so that the water film carries the ground material away and acts as a cooling medium. In the present patent application, when a ceramic roll is spoken of, what is meant is expressly a roll with a ceramic or metal-ceramic coating. The coating material is preferably an oxide ceramic, for example Al, Ca, Cr, Mg, Si, Ti, Zn, or Y oxide, or a carbide ceramic, for example Cr, Ni, Ti, or W carbide, or a boride ceramic, for example Ti boride, or a mixture or compound of same. Among these ceramics, it is also possible to alloy metals, for example Al, Cr, Co, Fe, Mo, Ni, Si, or alloys of same.

The method and the equipment in accordance with the invention are characterized in what is stated in the patent claims.

The invention will be described in the following with reference to some preferred embodiments of the invention illustrated in the figures in the accompanying drawings, the invention being, however, not supposed to be confined to said embodiments alone.

Figure 1A is a schematic illustration of smoothing of a roll face.

Figure 1B is a schematic illustration of roughening of a roll face.

Figure 2A shows graphs f_1,f_2 representing the roughness of the face. The curve f_1 represents roughening of the face. The curve f_2 represents smoothing of the face.

Figure 2B illustrates the grinding stage, in which the curve f_1' represents the smoothing of the face during grinding, and the curve f_2' represents the roughening of a smooth face during grinding.

Figure 3A shows the press of a paper machine in a running situation.

Figure 3B shows the grinding in accordance with the invention of the centre roll of the press.

Figure 4A is a more detailed side view of a grinding equipment in accordance with the invention. The illustration corresponds to a sectional view taken along the line I-I in Fig. 4B.

Figure 4B shows the equipment in the direction of the arrow K_1 in Fig. 4A.

Figure 5A shows the contact of the grinding member with the face to be ground on an enlarged scale.

Figure 5B shows the area X_1 in Fig. 5A.

Figure 6A shows a second embodiment of the invention, wherein the grinding band is attached directly to the doctor blade.

Figure 6B shows the area X_2 in Fig. 6A.

Figure 7 is an axonometric illustration of the fixing of the grinding band to the back-up part of the grinding member, and the design of the back-up part is described with reference to the figure.

Fig. 1A illustrates the cross-sectional structure of a ceramic roll face in a smoothing stage of the face. The material illustrated in the figure by means of diagonal shading represents the doctor material 11. In the smoothing stage of the face, especially in a thermally sprayed face, the sharp-edged recesses O_1,O_2... produced in connection with grinding, scratch the doctor material, and thereby the

recesses O_1,O_2 tend to be filled. This comes out as smoothing of the face.

Fig. 1B shows a second case, in which the face becomes rough. In Fig. 1B, the doctor material 11 is illustrated by the shaded areas. If the number and the size of the abrading particles entering between the blade and the roll are large, the particles start scratching the layer of doctor material that is formed more rapidly than it can be renewed. In this way, first the layer of doctor material is broken, and then the roughening of the ceramic layer becomes possible. By means of a grinding treatment, a new plane face is formed on the face, which promotes the formation of a layer of doctor material.

In Fig. 2A, the curve f_1 represents the roughening of the face, i.e. the situation of Fig. 1A, in a system of coordinates of surface roughness / running time. During the running time, the surface roughness approaches a certain maximal value.

In the figure, the curve f_2 represents the tendency of smoothing of the face. Depending on the particular case, the rate of change in the roughness may vary even to a considerable extent. It has been noticed that the maximal value approaches the RA value 2, and the minimal value the RA value 0.2. At the stage t_1, grinding is carried out in accordance with the invention.

As is shown in Fig. 2B, in the stage t_1, the face is ground by means of the grinding member, in which the average diameter size of the particles, i.e. the diameter of the granule (particle size), is in the range of 15...200 µm. Irrespective of whether the starting point is an excessively rough face or an excessively smooth face, the desired surface roughness is achieved. The curve f_1' illustrates the smoothing of the rough face taking place during grinding, and the curve f_2' illustrates the roughening of a smooth face taking place during grinding. The final result is obtained with a grinding time of about one to two hours.

Fig. 3A is a schematic illustration of the press section of a paper machine in a running situation. The press section shown in Fig. 3A comprises a centre roll 10 coated with a ceramic coating in accordance with the invention. Between the press roll 12 and the back-up roll 13 there is a nip N_1, between the centre roll 10 and the press roll 12 a nip N_2, and between the centre roll 10 and the back-up roll 14 a nip N_3. The felt H_2 and the web W are passed through the nips N_1 and N_2. In a corresponding way, the felt H_1 is passed through the nip N_1 and over the felt guide rolls $15a_1$, $15a_2$. After the nip N_2, the web is passed along the face 10' of the centre roll 10, while adhering to said roll face, into the nip N_3, into which the felt H_3 is also passed. The felt H_3 is passed over the felt guide rolls $16a_1$,$16a_2$. After the nip N_3, the web is passed a certain distance along the roll face 10' of the roll 10, being transferred over the roll 17 into connection with the felt H_4. The felt H_4 is guided over the felt guide roll 18. Under these circumstances, in press roll operation, very good and accurate properties are required from the face in order that, for example, in connection with threading and in a running situation, the web W could be transferred readily into connection with the centre roll and that the web could be passed away from the centre roll. In view of the quality of the paper that is produced, the properties of the roll face are also essential. If changes in the surface values take place on the ceramic material, the running situation is not under control. Thus, in the present patent application, it is suggested that the ceramic material should be ground periodically, i.e. at certain regular time intervals, for example in connection with suitable standstills for change of felts.

Fig. 3B shows a method and equipment of grinding in accordance with the invention. The nips N_1,N_2,N_3 have been opened, and the centre roll 10 is driven by means of its own drive gear in crawling operation. Alternatively, the roll may be driven by means of the drive of a back-up roll while the nip or nips are closed. The sense of rotation of the roll is indicated by the arrow D_1. At the end of the blade 29 of the doctor device 19, a grinding back-up part 20 is mounted, in which the grinding member 21 is preferably a diamond grinding band. The grinding band 21 is in contact with the face 10' to be ground over the circumferential distance L. It is essential that the distance L is in the range of 7...200 mm, preferably 10...100 mm, in which case an adequate number of grinding particles are in contact with the face to be ground in each position of the circumference, and that, during grinding, the material to be ground does not exhaust the grinding member 21, so that change of the grinding member 21 during each grinding cycle can be avoided. The grinding takes about 1...2 hours, and no breaks in time are necessary during grinding.

The speed of the roll 10 circumference that is used in the grinding situation is preferably in the range of 10...200 m/min.

Fig. 4A is a side view of the grinding arrangement on an enlarged scale. The illustration is a sectional view taken along the line I-I in Fig. 4B. In the way shown in Fig. 4A, the doctor 19 comprises a doctor beam 23, which is connected with a pivot arm 24. Between the pivot arm 24 and the frame F, there is an actuator 240, for example a cylinder device or a stud screw.

By means of the actuator 240, the doctor beam 23 is locked in the direction of rotation in the position of operation. Further, the solution of equipment comprises a pivot frame 26 connected with the projection part 23' of the doctor beam 23 and

fitted to pivot on an articulated joint 28. Between the pivot frame 26 and the projection part 23', loading hoses 27a and 27b are placed at both sides of the pivot joint 28. By means of the loading hoses 27a,27b, the pivot frame 26 can be pivoted on the pivot joint 28 (arrow L_1). In this way the blade 29 can be pressed, together with the grinding member 21 attached to it, with a force into contact with the face 10' to be ground. The blade 29 is fitted in the cavity 26' in the end of the pivot frame 26. According to the invention, the grinding back-up part 20 is mounted by means of the articulation point 30 on the blade 29 end. The grinding back-up piece 20 comprises a grinding member 21, favourably exactly a grinding band, preferably a diamond grinding band. The average particle size of the grinding particles in the grinding member 21 is in the range of 15...200 µm. In the figure, the jet pipe 22 produces a water jet S, which is sprayed onto the face to be ground, whereby the grinding material can be carried away from the roll face 10' along with the water.

Fig. 4B shows the equipment of Fig. 4A as viewed in the direction of the arrow K_1 in Fig. 4A. The oscillation actuator 31 is fitted to displace the shaft E_1 of the doctor 19, which shaft E_1 is supported in the bearing housing E_2. The movement of oscillation is illustrated by the arrows L_2,L_3.

Fig. 5A is an enlarged illustration of the connection of the back-up part 20 and of the grinding member 21 fitted on same with the face 10' to be ground. The back-up part 20 has a shape R_1, which corresponds to the radius R_2 of the roll 10 closely. The blade 29 of the doctor is mounted in the groove 20a in the back-up part 20. The groove 20a runs in the back-up part 20 on its outer face 20" across the entire width of the roll 10 to be ground.

Fig. 5B shows the area X_1 in Fig. 5A. The grinding band 21 is in contact with the roll face 10' preferably over the circumferential distance L. The length of the area L is favourably in the range of 7...200 mm, preferably 10...100 mm.

The cushion material 25 is placed between the grinding band 21 and the grinding back-up part 20.

Fig. 6A shows a second embodiment of the invention, in which an excessively wide blade 290 is fixed to the doctor 19, which blade 290 is flexible. The grinding band 21 is fixed to the blade 290 face 290', and the cushion material 25 is fitted between the grinding band 21 and the blade face 290' of the blade 290.

Fig. 6B is an enlarged illustration of the area X_2 in Fig. 6A.

Fig. 7 illustrates the shape of the grinding back-up part 20 in accordance with the invention and the fixing of the grinding band 21 and the cushion material 20b to the curved face 20' of the grinding back-up part 20. The shape R_1 of the face 20' corresponds closely to the radius R_2 of the roll 10. In the arrangement, the grinding member 21 is capable of adapting itself to the face 10' to be ground so that any variations in the surface pressure, arising from inaccuracies in the contact between the face 10' to be ground and the grinding member 21, are equalized in the grinding situation. The grinding back-up part 20 comprises a groove 20a on its outer face 20", into which groove the end of the blade 29 of the doctor 19 is fitted, whereby an articulated joint 30 is formed between the blade 29 and the grinding back-up part 20. In such a case, the grinding back-up part 20 is guided as gently as possible in compliance with the surface forms of the roll in the grinding situation. The time taken by the grinding is preferably one to two hours. The grinding band 21 or any other grinding member is pressed with a force of 100...1200 N/m against the roll face 10' to be ground, and the roll is rotated with a circumferential speed of about 10...200 m/min.

The invention concerns a method and an equipment in conditioning of the coating (10') on a roll (10) in a paper machine, which coating is ceramic or metal-ceramic. The roll (10) is ground periodically by means of a grinding member (21), which is mounted on the doctor (19) of the roll (10). The grain size of the grinding particles in the grinding member (21), i.e. the average diameter of the particles, is in the range of 15...200 µm. In the grinding situation, the roll (10) is rotated in its site of operation, and the grinding member (21) is pressed with a force into contact with the face to be ground, whereby, if the face to be ground is excessively rough, it is smoothed to the desired value of surface roughness and, in a corresponding way, an excessively smooth face is roughened to the desired surface roughness value determined by the grinding member (21).

Claims

1. Method in conditioning of the coating (10') on a roll (10) in a paper machine, which coating is ceramic or metal-ceramic, **characterized** in that the roll (10) is ground periodically by means of a grinding member (21), which is mounted on the doctor (19) of the roll (10), and that the grain size of the grinding particles in the grinding member (21), i.e. the average diameter of the particles, is in the range of 15...200 µm, and that, in the grinding situation, the roll (10) is rotated in its site of operation, and the grinding member (21) is pressed with a force into contact with the face to be ground, whereby, if the face to be ground is excessively rough, it is smoothed to the desired

value of surface roughness and, in a corresponding way, an excessively smooth face is roughened to the desired surface roughness value determined by the grinding member (21).

2. Method as claimed in claim 1, **characterized** in that, during grinding, the grinding member (21) is pressed against the roll face (10') by means of the actuator (27a,27b) of the doctor (19) of the roll (10) with a force of 100...1200 N/m, and that the grinding member (21) is oscillated (L_2,L_3) in the axial direction of the roll similarly by means of the oscillation actuator (31) of the doctor (19).

3. Method as claimed in claim 1 or 2, **characterized** in that, during grinding, the roll (10) is rotated at a circumferential speed of 10...200 m/min, and a grinding medium, preferably water, is sprayed onto the face (10') to be ground.

4. Method as claimed in any of the preceding claims, **characterized** in that the grinding member (21) is attached to the construction of the doctor (19) so that a cushion material (25) is placed between the doctor constructions and the grinding member (21), an adequate capacity of deformation being permitted for the grinding member (21) by means of the cushion material (25) in the grinding situation, in which case the grinding member (21) can adapt itself to the shape of the face (10') to be ground, so that any variations in the surface pressure, arising from inaccuracies in the contact between the face (10') to be ground and the grinding member (21), are equalized in the grinding situation.

5. Method as claimed in any of the preceding claims, **characterized** in that, in the method, a grinding band is used as the grinding member (21), whose width (L) is in the range of 7...200 mm, preferably 10...100 mm.

6. Method as claimed in any of the preceding claims, **characterized** in that the grinding member (21) is placed on a grinding back-up part (20), which is further mounted on the end of the blade (29) of the doctor (19), and that, in the method, there is an articulation point (30) between the grinding back-up part (20) and the blade (29), a pivoting movement being permitted for the grinding back-up part (20) by means of said articulation point.

7. Method as claimed in any of the preceding claims, **characterized** in that such a grinding back-up part (20) is used as comprises a curved face (20'), to which the grinding band (21) and the cushion material (23) are fixed so that the cushion material (25) is placed between the grinding band (21) and the curved face (20') of the grinding back-up part (20).

8. Method as claimed in any of the preceding claims, **characterized** in that, in the method, a resilient blade (290) is used, to whose face the grinding band (21) and the cushion material (25) are fixed so that the cushion material (25) is placed between the grinding band (21) and the blade (290) face (290').

9. Equipment in conditioning of the coating on a roll (10) in a paper machine, which coating is ceramic or metal-ceramic, **characterized** in that there is a separate grinding member (21), which is placed into contact with the roll (10) face (10') periodically at certain time intervals, and that the equipment comprises a coupling arrangement between the doctor (19) of the roll (10) and the grinding member (21), the grinding member (21) being detachably connectable with the doctor (19), preferably with its blade (29), directly or by the intermediate of an intermediate part, preferably a grinding back-up part (20) used in grinding.

10. Equipment as claimed in the preceding claim, **characterized** in that the average particle size (diameter) of the grinding particles in the grinding member (21) is in the range of 15...200 µm.

11. Equipment as claimed in claim 9 or 10, **characterized** in that there is a cushion material (25), which is placed between the grinding member and the constructional parts of the doctor (19).

12. Equipment as claimed in any of the preceding claims 9 to 11, **characterized** in that the length (L) of the grinding member (21) in the direction of the circumference, over which distance the grinding member (21) is in contact with the face (10') to be ground, is in the range of 7...200 mm, preferably 10...100 mm.

13. Equipment as claimed in any of the preceding claims 9 to 12, **characterized** in that the grinding back-up part (20) comprises, extending over the length of the grinding back-up part, a groove (20a) passing on one of its sides (20''), into which groove the end of the blade

(29) of the doctor (19) is placed, a pivoting articulated joint (30) being formed between the blade (29) and the back-up part (20).

14. Equipment as claimed in the preceding claim, **characterized** in that the grinding back-up part (20) comprises a face (20') closely complying with the curve form of the roll, the cushion material (25) and the grinding band (21) that constitutes the grinding member being placed against said face (20').

15. Equipment as claimed in any of the preceding claims 9 to 13, **characterized** in that the grinding member (21) is a diamond grinding band.

16. Equipment as claimed in any of the preceding claims 9 to 15, **characterized** in that the grinding band (21) is fixed to the face (290') of the flexible blade (290) of the doctor (19).

17. Equipment as claimed in the preceding claim, **characterized** in that the cushion material (25) is placed between the blade face (290') of the blade (290) and the grinding band (21).

18. Equipment as claimed in any of the preceding claims 9 to 17, **characterized** in that there is a jet pipe (22) or equivalent, through which a grinding medium, preferably water, is passed so as to carry away the particles that have been ground loose as well as to constitute a cooling medium.

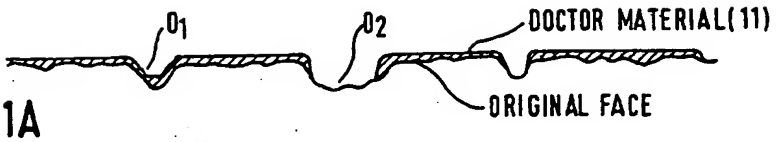


FIG. 1A

FIG.1B

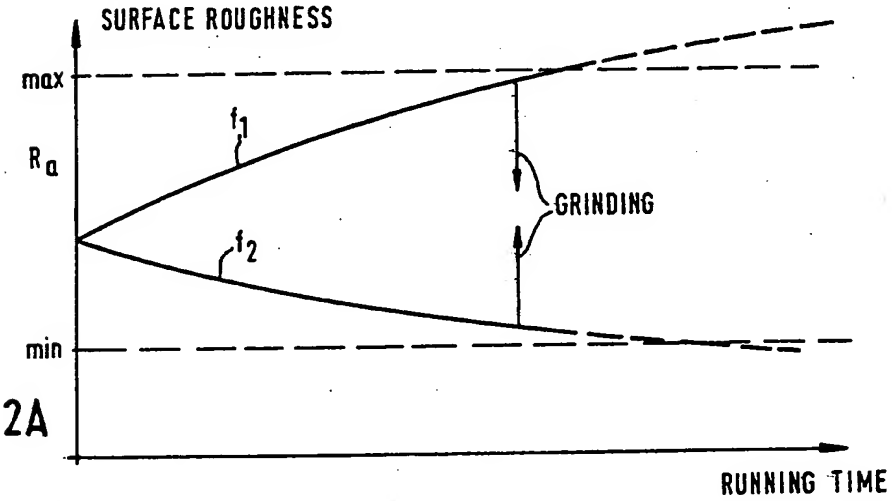


FIG. 2A

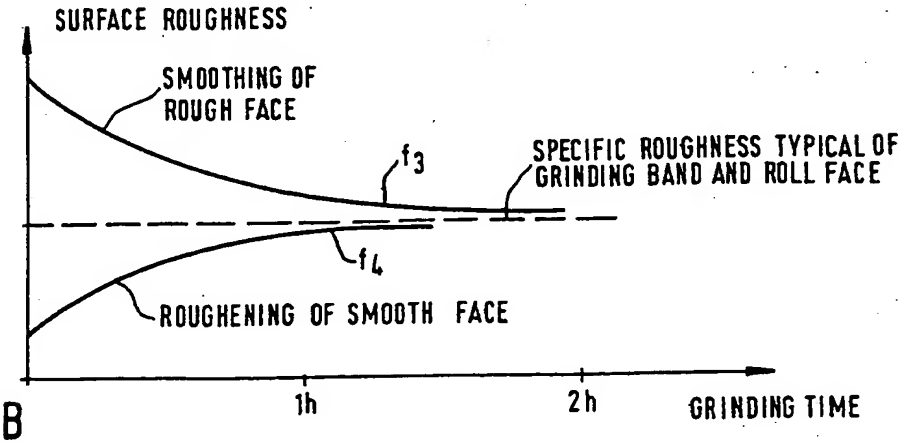


FIG.2B

FIG. 3A

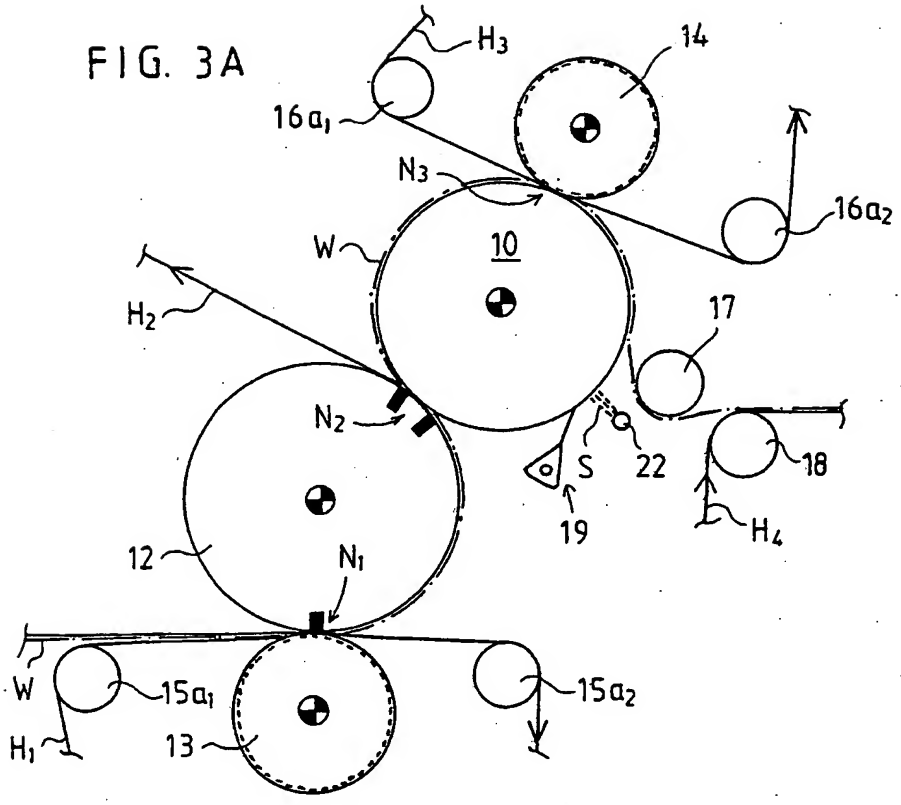
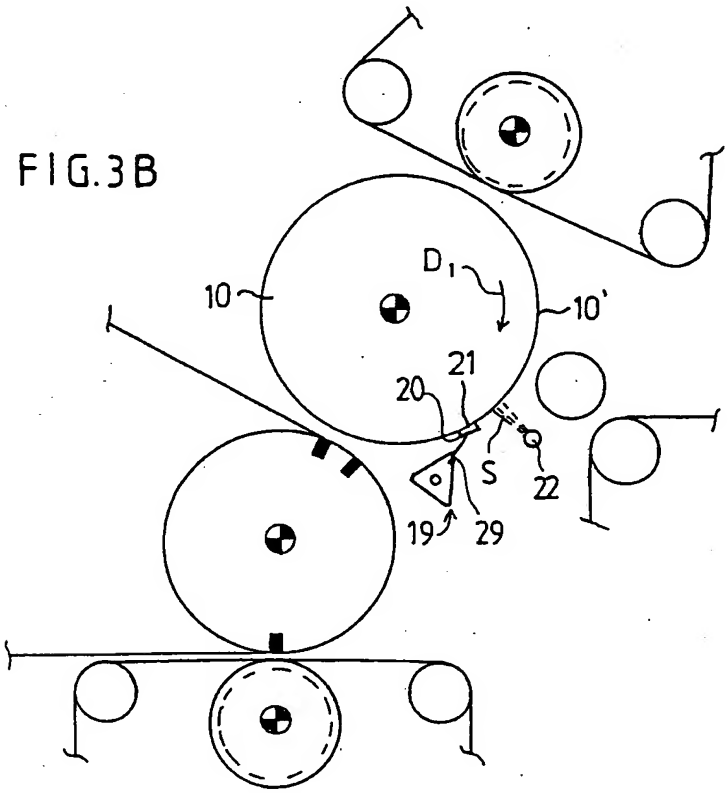

H3
14
16a1
N3
16a2
W
10
H2
17
N2
S
22
18
19
H4
12
N1
W
15a1
15a2
H1
13

FIG.3B


D1
10
10'
21
20
S
22
19
29

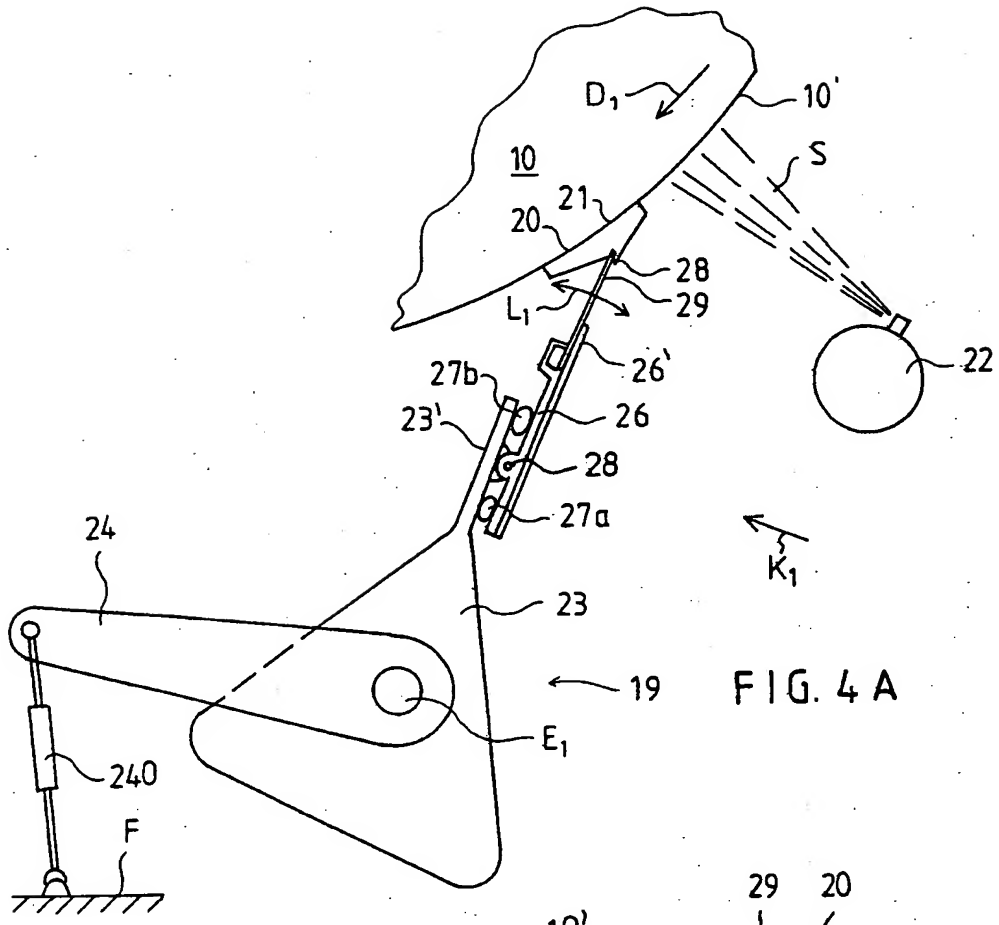

D1
10'
10
S
21
20
28
29
L1
22
26'
27b
26
23'
28
27a
K1
24
23
19
E1
240
F

FIG. 4 A

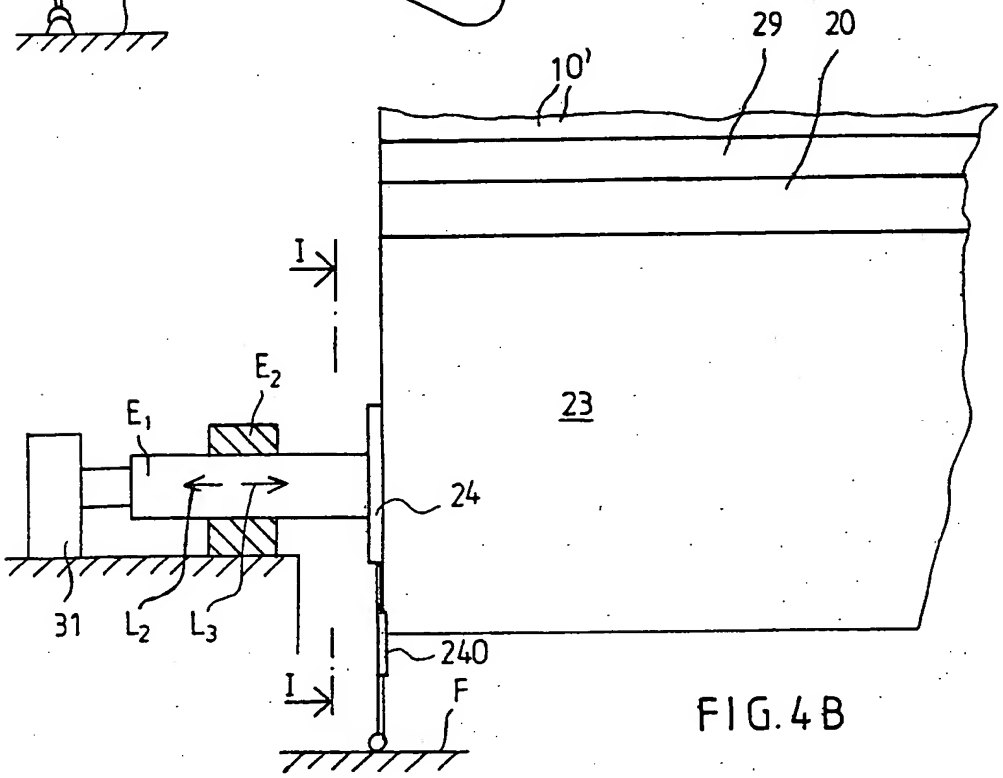

29
20
10'
I
E2
E1
23
24
31
L2
L3
240
I
F

FIG. 4B

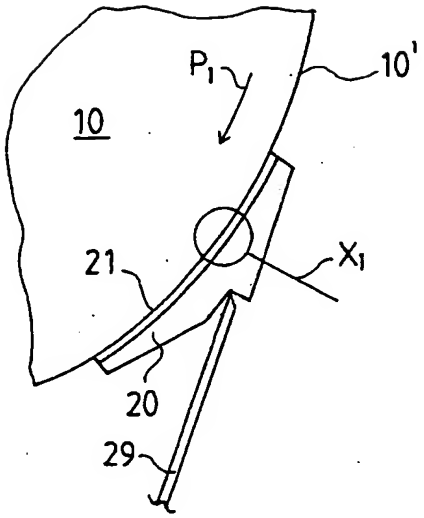


FIG. 5A

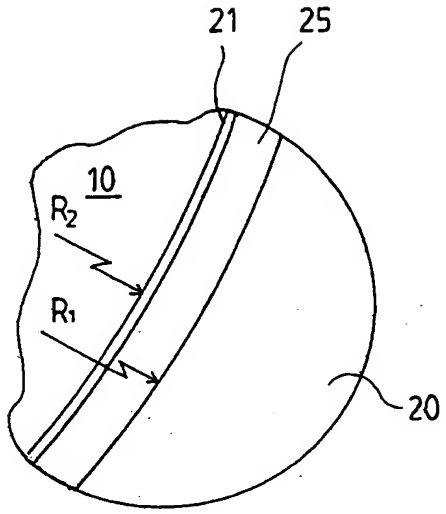


FIG. 5B

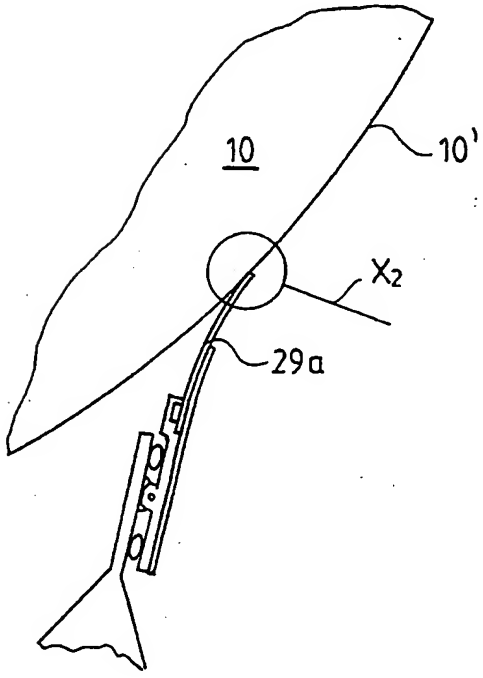


FIG. 6A

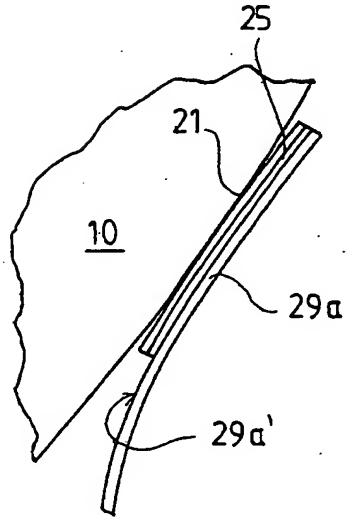


FIG. 6B

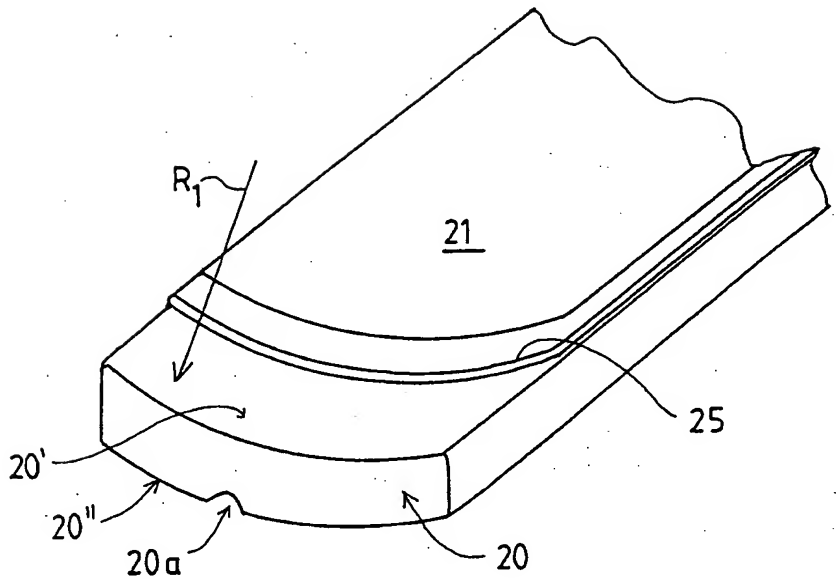


FIG. 7